The following is the "exact" climate change language

Final SEIS for LaSalle Units 1 and 2: [HYPERLINK "http://www.nrc.gov/docs/ML1623/ML16238A029.pdf"]

4.15.3 Greenhouse Gas Emissions and Climate Change (4-104) (EPA Commented on this section NRC changes are reflected by bold and underlined text
)

The following sections discuss GHG emissions and climate change impacts. Section 4.15.3.1 evaluates GHG emissions associated with operation of LSCS and replacement power alternatives**. Section 4.15.3.2 discusses the observed changes in climate, the potential future climate change during the license renewal term based on climate model simulations under future global GHG emission scenarios, and the impacts of climate change on affected resources.** The cumulative impacts of global GHG emissions on climate are discussed in Section 4.16.11, "Global Climate Change."

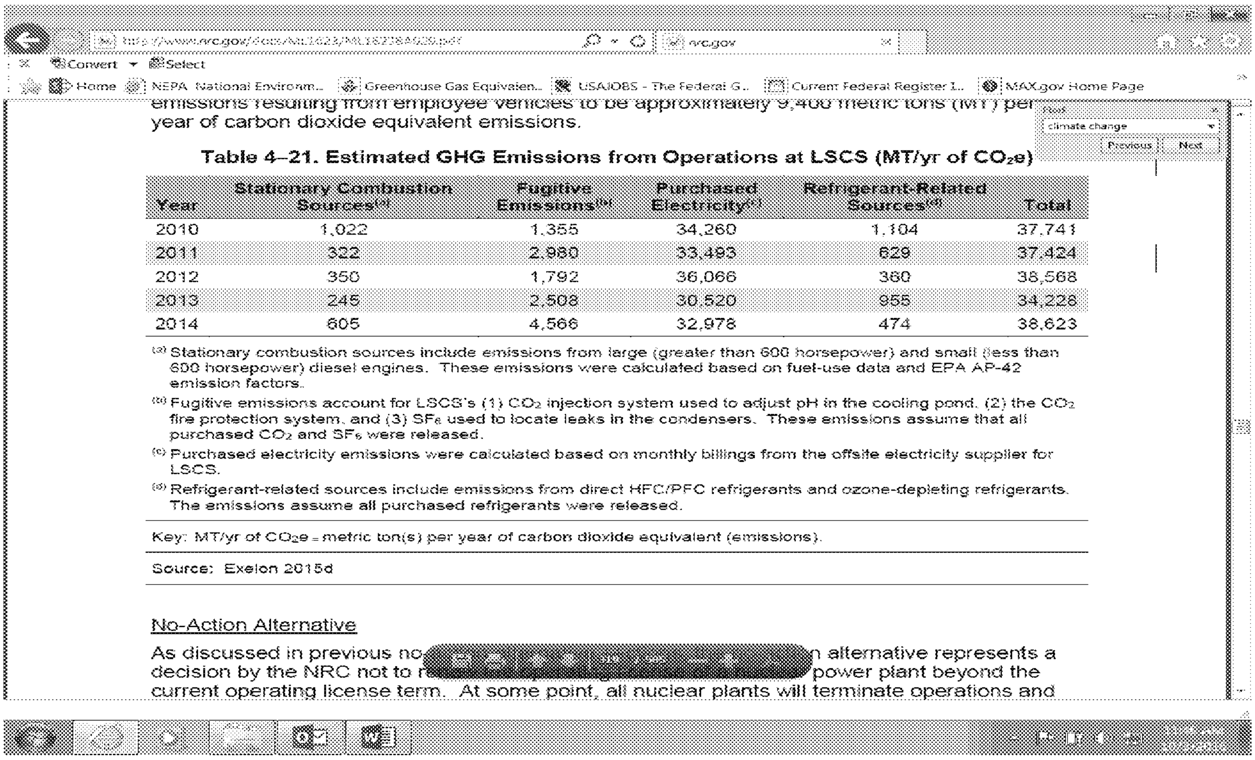
4.15.3.1 Greenhouse Gas Emissions from the Proposed Project and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed GHG. GHGs include carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); water vapor (H_2O); and fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The Earth's climate responds to changes in concentrations of GHGs in the atmosphere because GHGs affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing GHG concentrations in the atmosphere generally increases Earth's surface temperature. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have significantly increased since 1750 (IPCC 2007c, 2013). Carbon dioxide, methane, nitrous oxide, water vapor, and fluorinated gases (termed long-lived GHGs) are well mixed throughout the Earth's atmosphere, and their impact on climate is long lasting as a result of their long atmospheric lifetime (EPA 2009a). Carbon dioxide is of primary concern for global climate change, due to its long atmospheric lifetime, and it is the primary gas emitted as a result of human activities. Climate change research indicates that the cause of the Earth's warming over the last 50 years is due to the buildup of GHGs in the atmosphere resulting from human activities (USGCRP 2014; IPCC 2013). The EPA has determined that GHGs "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496).
and to endanger public welfare" (74 FR 66496).

Proposed Action

Operation of LSCS emits GHGs directly and indirectly. LSCS's direct GHG emissions result from stationary combustion sources (i.e., diesel generators on site), refrigerant appliances that contain fluorinated gases, LSCS's carbon dioxide injection system and fire protection system, and use of sulfur hexafluoride to locate leaks in condensers (Exelon 2015d). Indirect GHG emissions originate from mobile combustion sources (employee vehicle GHG emissions and nonroad equipment) and purchased electricity generated off site.

Annual direct GHG emissions at LSCS and indirect GHG emissions attributable to purchased electricity generated off site are presented in Table 4-21 for the 2010 to 2014 timeframe. Employee vehicle GHG emissions are not provided in Table 4-21 because Exelon does not compile or report GHG data for mobile sources. The NRC staff estimates annual GHG emissions resulting from employee vehicles to be approximately 9,400 metric tons (MT) per
year of carbon dioxide equivalent emissions.



emissions resulting from employee vehicles to be approximately 9,400 metric tons (MT) per year of carbon dioxide equivalent emissions.

Table 4–21. Estimated GHG Emissions from Operations at LSCS (MT/yr of CO_2e)

Year	Stationary Combustion Sources[a]	Fugitive Emissions[b]	Purchased Electricity[c]	Refrigerant-Related Sources[d]	Total
2010	1,022	1,355	34,260	1,104	37,741
2011	322	2,980	33,493	629	37,424
2012	350	1,792	36,066	360	38,568
2013	245	2,508	30,520	955	34,228
2014	605	4,566	32,978	474	38,623

[a] Stationary combustion sources include emissions from large (greater than 600 horsepower) and small (less than 600 horsepower) diesel engines. These emissions were calculated based on fuel-use data and EPA AP-42 emission factors.

[b] Fugitive emissions account for LSCS's (1) CO_2 injection system used to adjust pH in the cooling pond, (2) the CO_2 fire protection system, and (3) SF_6 used to locate leaks in the condensers. These emissions assume that all purchased CO_2 and SF_6 were released.

[c] Purchased electricity emissions were calculated based on monthly billings from the offsite electricity supplier for LSCS.

[d] Refrigerant-related sources include emissions from direct HFC/PFC refrigerants and ozone-depleting refrigerants. The emissions assume all purchased refrigerants were released.

Key: MT/yr of CO_2e = metric ton(s) per year of carbon dioxide equivalent (emissions).

Source: Exelon 2015d

No-Action Alternative

As discussed in previous no … n alternative represents a decision by the NRC not to r … power plant beyond the current operating license term. At some point, all nuclear plants will terminate operations and

No-Action Alternative
As discussed in previous no-action alternative sections, the no-action alternative represents a decision by the NRC not to renew the operating license of a nuclear power plant beyond the current operating license term. At some point, all nuclear plants will terminate operations and undergo decommissioning. Under the no-action alternative, plant operations for LSCS would terminate at or before the end of the current license term. When the plant stops operating, a reduction in GHG emissions from activities related to plant operation, such as use of diesel
generators and employee vehicles, will occur. The GHG emissions are anticipated to be less than those presented in Table 4-21.

New Nuclear Alternative
As discussed in Section 2.2.2.1, the NRC staff evaluated the new nuclear power plant

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alternative that would consist of two units with an approximate generating capacity of 1,120 megawatt electric (MWe) each. The GEIS (NRC 2013d) presents life-cycle GHG emissions associated with nuclear power generation. As presented in Tables 4.12-4

through 4.12-6 of the GEIS, life-cycle[5] GHG emissions from nuclear power generation can range from 1 to 288 grams of carbon equivalent per kilowatt hour (g C_e/kWh). Operation of nuclear power plants does not burn fossil fuels to generate electricity and, therefore, does not emit GHG emissions. Sources of GHG emissions include stationary combustion sources (e.g., emergency diesel generators and diesel-driven pumps) and mobile sources (e.g., worker vehicles, onsite heavy equipment, support vehicles, delivery of materials, and disposal of wastes). It is anticipated that air emissions from a new nuclear power plant would be similar to those from LSCS.

IGCC Generation Alternative

As discussed in Section 2.2.2.2, the NRC staff evaluated the IGCC plant alternative that would consist of four 618-MWe units for a total 2,472 MW. The GEIS presents life-cycle GHG emissions associated with coal power generation. As presented in Table 4.12-4 of the GEIS, life-cycle GHG emissions from coal power generation can range from 264 to 1,689 g C_{eq}/kWh. However, these life-cycle emission factors are for conventional coal power plants; recent studies estimate life-cycle GHG emissions for an IGCC plant to be 937 kilograms of carbon dioxide equivalent per megawatt-hour (kg $CO_{2}e$/MWh) (NETL 2012). The NRC staff estimates that operation of the IGCC alternative directly will emit about 14.3 million tons per year (13.0 million MT per year) of carbon dioxide equivalent emissions.

NGCC Generation Alternative

As discussed in Section 2.2.2.3, the NRC staff evaluated an NGCC alternative that consists of five NGCC 560-MWe units (total 2,800 MWe). The GEIS presents life-cycle GHG emissions associated with natural gas power generation. As presented in Table 4.12-5 of the GEIS, life-cycle GHG emissions from natural gas can range from 120 to 930 g C_{eq}/kWh. The NRC staff estimates that operation of the NGCC alternative directly will emit about 9.8 million tons (8.2 million MT) per year of carbon dioxide equivalent emissions.

Combination Alternative (NGCC, Wind, and Solar)

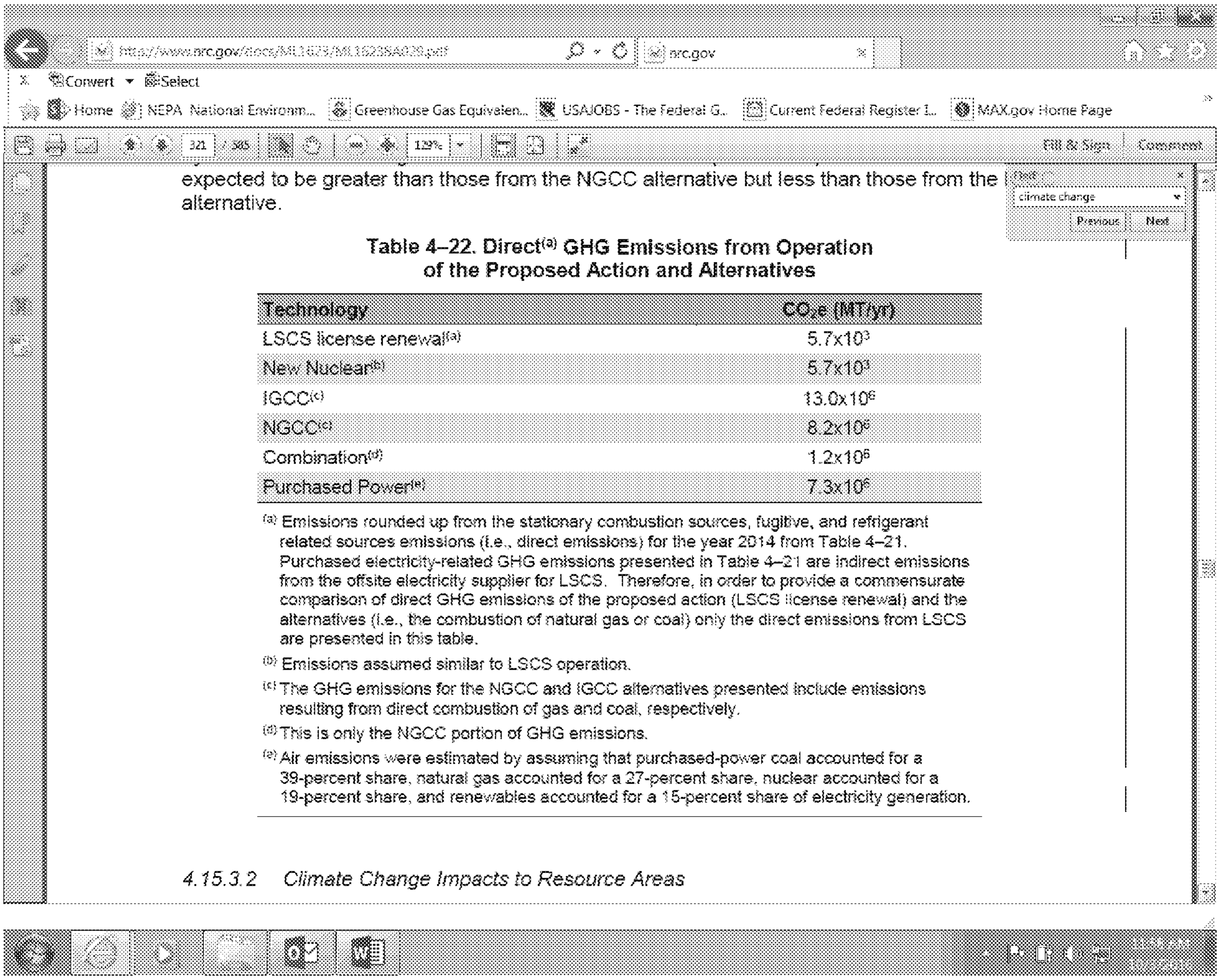
As discussed in Section 2.2.2.4, the NRC staff evaluated an alternative that relies on NGCC (15 percent), wind (75 percent), and solar (10 percent) capacity to replace LSCS. The combination alternative would consist of a 360-MWe NGCC unit, a 227-MWe solar PV facility, and a 1,813-MWe windfarm. For this combination alternative, it is assumed that the majority of the GHG emissions result from the NGCC portion only because renewable portions (wind and solar PV) do not burn fossil fuels to generate electricity. As discussed in Section 4.3.5., GHG emissions associated with the operation of the NGCC portion are reduced proportionally because its electricity output is approximately 13 percent that of the NGCC alternative. The NRC staff estimates that operation of the combination alternative will directly result in about 1.3 million tons (1.2 million MT) per year of carbon dioxide equivalent emissions.

Purchased Power Alternative

Purchased power would come from common types of existing technology (coal, natural gas, nuclear, and renewable sources) within the ROI. GHG emissions from purchased power will vary and will depend on the type and combination of technology from which purchased power originates. In 2014, coal, natural gas, and nuclear power accounted for 39-, 27-, and 19-percent shares, respectively, of total U.S. electricity generation (EIA 2015b). Using these percentage shares for the purchased power alternative, the NRC staff estimates 8.0 million ton (7.3 million MT) per year of carbon dioxide equivalent emissions. However, GHG emissions may be greater or less than this estimate and will depend on the technology from which the purchased power originates.

Summary of GHG Emissions from the Proposed Action and Alternatives

Table 4-22 presents the direct GHG emissions from operation of the proposed action and alternatives. GHG emissions from the proposed action (license renewal) and the new nuclear alternative would be the lowest. GHG emissions for IGCC, NGCC, combination, and purchased power alternatives are higher than those for the proposed action and a new nuclear alternative by several orders of magnitude. GHG emissions from the purchased power alternative are expected to be greater than those from the NGCC alternative but less than those from the IGCC alternative.



expected to be greater than those from the NGCC alternative but less than those from the alternative.

Table 4–22. Direct[a] GHG Emissions from Operation of the Proposed Action and Alternatives

Technology	CO_2e (MT/yr)
LSCS license renewal[a]	5.7×10^3
New Nuclear[b]	5.7×10^3
IGCC[c]	13.0×10^6
NGCC[c]	8.2×10^6
Combination[d]	1.2×10^6
Purchased Power[e]	7.3×10^6

[a] Emissions rounded up from the stationary combustion sources, fugitive, and refrigerant related sources emissions (i.e., direct emissions) for the year 2014 from Table 4–21. Purchased electricity-related GHG emissions presented in Table 4–21 are indirect emissions from the offsite electricity supplier for LSCS. Therefore, in order to provide a commensurate comparison of direct GHG emissions of the proposed action (LSCS license renewal) and the alternatives (i.e., the combustion of natural gas or coal) only the direct emissions from LSCS are presented in this table.

[b] Emissions assumed similar to LSCS operation.

[c] The GHG emissions for the NGCC and IGCC alternatives presented include emissions resulting from direct combustion of gas and coal, respectively.

[d] This is only the NGCC portion of GHG emissions.

[e] Air emissions were estimated by assuming that purchased-power coal accounted for a 39-percent share, natural gas accounted for a 27-percent share, nuclear accounted for a 19-percent share, and renewables accounted for a 15-percent share of electricity generation.

4.15.3.2 Climate Change Impacts to Resource Areas

Climate Change Considerations (Page 4-119)

The NRC staff also considered the USGCRP's most recent compilations of the state of knowledge relative to global climate change effects (USGCRP 2014). Climate change can impact surface water as a result of changes in temperature and precipitation. As discussed in Section 4.15.3.2, climate model simulations for the Midwest region indicate an increase in annual mean temperature as well as precipitation. More especially, the frequency and intensity of heavy precipitation events is forecast to increase. Increased precipitation results in greater runoff and streamflow. The USGCRP (USGCRP 2014) predicts that runoff and streamflow for the upper Midwest will increase overall.

In its ER, Exelon (2014a) cites an analysis prepared by the Illinois State Water Survey (Knapp 2009) that assesses trends in stream flows encompassing the Illinois River Basin and their implications for flood frequency. For stream gaging sites with a long period of record (90 years), the analysis indicates a consistent trend of increasing stream flows in the upper Midwest, attributed to a 7- to 10-percent increase in precipitation over the past 30 years (through 2008). Results from an earlier study prepared by USGS (Arnold et al. 1999) and specific to the Upper Illinois River Basin also indicate a statistically significant increase in mean annual stream flow (over the period 1950-1997) at all seven stations selected for analysis, including as measured at the USGS gage at Marseilles, Illinois. In contrast to Knapp (2009), the USGS study was not able to correlate any trends in precipitation with the apparent increases in streamflow. Rather, the authors concluded that the observed trends were more likely attributable to land-use changes in the affected watersheds, causing more rapid runoff of precipitation, and to increases in groundwater usage and associated increased return effluent to receiving waters from wastewater treatment plants in the basin. These two studies serve to point to the uncertainty over whether there has been an observable trend in precipitation and/or streamflow in the upper Midwest, as forecast by the USGCRP.

Despite any observable trends to date, rapid runoff events occurring due to more frequent and intensive precipitation events associated with climate change, especially over cleared or urbanized areas, will result in increases in erosion and transport of sediment and other pollutants to receiving waters. This can negatively affect ambient water quality.

Further, higher air temperatures and increased runoff associated with heavy precipitation events could impact the thermal regime of the Marseilles Pool of the Illinois River, along with increases in runoff laden with nutrients, sediment, and other contaminants. Higher surface water temperatures decrease the cooling efficiency of thermoelectric power generating facilities as well as plant capacity, due to the need to reduce the discharge of thermal effluent (USGCRP 2014). As intake water temperatures warm, cooling water makeup requirements increase. Degradation in ambient surface water quality increases the costs of water treatment for both industrial cooling water and potable water, due to the need for increased filtration and higher additions of chemical treatments for such uses as antiscaling and disinfection. With respect to LSCS operations, these potential climate-induced changes can lead to higher cooling pond temperatures and an increase in evaporative losses from LSCS' s cooling pond. This can conceivably result in additional makeup water withdrawals from the Marseilles Pool and an increased need for blowdown discharges from the cooling pond to the Illinois River. At present, the data available to the NRC staff is not sufficient to indicate whether or not a warming trend is evident in the waters of the Illinois River, including the Marseilles Pool. Exelon (2015b) has not identified any increasing trend in cooling pond temperatures to date, although this observation is based on limited data. Regardless, as detailed in Section 3.5.1.3 of this SEIS, the chemical and thermal quality of LSCS' s discharges to the Illinois River are subject to the effluent limitations and monitoring requirements prescribed by its NPDES permit (IEPA 2013). Additionally, thermal mixing zone limits set by LSCS' s NPDES permit indirectly limit surface water withdrawals and consumptive water use during low river flow and extreme summer weather events.

Future thermal and pollutant discharges from new and modified industrial and large commercial facilities in the lowermost Upper Illinois River Basin would be required to comply with applicable NPDES permit requirements under the Federal CWA, local and regional health standards, and TMDLs imposed by the State of Illinois.

Conclusion
Surface water availability is expected to continue to be sufficient through the license renewal term, based on the projections and associated assumptions cited above. Surface water from the Marseilles Pool of the Illinois River has been able to support ongoing demands for uses ranging from navigation to cooling and thermoelectric power generation to commercial and industrial water supply. Flows within the Upper Illinois River Basin and through the Marseilles Pool are not likely to decrease and may trend higher during the LSCS license renewal term, in part due to climate-induced hydrologic changes. No increase in LSCS consumptive water use is expected during the license renewal term. Surface water withdrawals and associated consumptive water use for LSCS operations are expected to remain a small percentage of the mean annual and 90-percent exceedance flow through the Marseilles Pool of the Illinois River.

It is reasonable to anticipate that water-quality-based limits imposed by the IEPA through NPDES permits and other measures on cooling water, wastewater, and stormwater discharges and similar limits on sources of development, agricultural, and urban runoff will continue to maintain or improve ambient surface water quality in the Illinois River. LSCS's combined cooling pond blowdown, wastewater, and stormwater discharges to the Illinois River are regulated under an IEPA-administered NPDES permit. Available data indicate that LSCS operations are a very small contributor to the pollutant and thermal loading to the Illinois River. Based on the foregoing, the NRC staff concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions and trends on surface water resources during the license renewal term would be SMALL.

4.16.11 Global Climate Change (Page 4-129)
This section addresses the impact of GHG emissions resulting from continued operation of LSCS on global climate change when added to the aggregate effects of other past, present, and reasonably foreseeable future actions.

The impacts of climate change on air, water, and ecological resources are discussed in Section 4.15.3. Climate is influenced by both natural and human-induced factors; the observed global warming (increase in Earth's surface temperature) in the 21st century has been attributed to the increase in GHG emissions resulting from human activities (USGCRP 2009). Climate model projections indicate that future climate change is dependent on current and future GHG emissions (IPCC 2007b; USGCRP 2009, 2014). As described in Section 4.15.3.1, operations at LSCS emit GHG emissions.

The cumulative impact of a GHG emission source on climate is global. GHG emissions are transported by wind and become well mixed in the atmosphere as a result of their long atmospheric residence time. Therefore, the extent and nature of climate change is not specific to where GHGs are emitted. In April 2015, EPA published the official U.S. inventory of GHG emissions, which identifies and quantifies the primary anthropogenic sources and sinks of GHGs. The EPA GHG inventory is an essential tool for addressing climate change and participating with the United Nations Framework Convention on Climate Change to compare the relative global contribution of different emission sources and GHGs to climate change. In 2013, the United States emitted 6,673 teragrams (Tg) (6,673 million metric tons (MMT)) of carbon dioxide equivalents (CO_2e), and from 1990 to 2013, emissions increased by 5.9 percent (EPA 2015d). In 2012 and 2013, the total amount of CO_2e emissions related to electricity generation was 2,022 Tg (2,022 MMT) and 2,039 Tg (2,039 MMT), respectively (EPA 2015d). The Energy Information Administration (EIA) reported that, in 2013, electricity production alone in Illinois was responsible for 94.1 MMT CO_2e (EIA 2015a). Facilities that emit 25,000 MT CO_2e or more per year are required to annually report their GHG emissions to EPA. These facilities are known as direct emitters, and the data are publicly available in EPA's facility-level information on GHGs tool (FLIGHT). In 2013, FLIGHT identified 11 facilities in LaSalle County, Illinois, where LSCS is located, that emitted a total of 0.89 MT CO_2e (EPA 2015c). In 2012, FLIGHT identified 290 facilities in Illinois that emitted a total of 134 MMT CO_2e (EPA 2015c).

Appendix E provides a list of current and reasonably foreseeable future projects and actions that could contribute to GHG emissions. Permitting and licensing requirements and other mitigative measures can minimize the impacts of GHG emissions. For instance, in 2012, EPA issued a final GHG Tailoring Rule (77 FR 41051) to address GHG emissions from stationary sources under the CAA permitting requirements; the GHG Tailoring Rule establishes when an emission source will be subject to permitting requirements and control technology to reduce GHG emissions. On June 25, 2013, President Obama set forward a plan to reduce carbon pollution. The Climate Action Plan will reduce carbon pollution, prepare the United States for the impacts of climate change, and lead international efforts to combat global climate change. The Clean Power Plan Final Rule[7] (80 FR 64661), aimed at reducing carbon pollution from power plants, requires carbon emissions from the power sector to be 32 percent below 2005 levels (870 million tons less). The Clean Power Plan sets forth carbon dioxide emission performance rate standards for fossil fuel-fired power plants that should be achieved by 2030. Future actions and steps taken to reduce GHG emissions can lessen the impacts on climate change.

In 2006, Illinois Executive Order (E.O. 06-11) created the Illinois Climate Change Advisory Group (ICCAG), which was charged with recommending State-level strategies to meet statewide GHG reduction goals. The Illinois GHG reduction goals are as follows: reduction of GHG emissions to 1990 levels (231 MT CO_2e) by 2020 and 60 percent below 1990 levels by 2050. The ICCAG's 2007 report identified that between1995-1997 nuclear generation capacity decreased in Illinois with the decrease replaced with coal generation along with an increase in GHG emissions (ICCAG 2007). As presented in Table 4-22, the IGCC, NGCC, combination, and purchased power alternatives' annual GHG emissions are higher by several orders of magnitude than those from continued operation of LSCS. Therefore, if LSCS's generating capacity were to be replaced by other non-nuclear power generating alternatives assessed in this SEIS, there would be an increase in GHG emissions, as was observed in 1995-1997 for Illinois. If non-nuclear replacement power alternatives were to be located in Illinois, the associated increase in GHGs may result in the implementation of additional State-level strategies (ICCAG 2007) to meet Illinois GHG reduction goals. Consequently, continued operation of LSCS (the proposed action) results in GHG emissions avoidance.

EPA's U.S. inventory of GHG emissions illustrates the diversity of GHG sources, such as electricity generation (including fossil fuel combustion and incineration of waste), industrial processes, and agriculture. As presented in Section 4.15.3, annual direct GHG emissions from combustion sources resulting from ancillary operations at LSCS range from 4,514 to 7,659 MT CO_2e. In comparing LSCS's GHG emission contribution to different emissions sources, whether it be total U.S. GHG emissions, emissions from electricity production in Illinois, or emissions on a county level, GHG emissions from LSCS are minor relative to these inventories; this is evident, as presented in Table 4-23. Further, total annual LSCS GHG emissions are below EPA's reporting threshold of 25,000 MT CO_2e, as codified in 40 CFR Part 98.

The emissions impact of a single source on climate change requires that a climate model account for that specific emissions source in order to project the magnitude and extent of climate change. Climate models indicate that short-term climate change (through the year 2030) is dependent on past GHG emissions. Therefore, climate change is projected to occur with or without present and future GHG emissions from LSCS. The NRC staff concludes that the incremental impact from the contribution of GHG emissions from the proposed action of the continued operation of LSCS on climate change would be SMALL.

Due to the global significance of GHG emissions, this global climate change cumulative impacts analysis considers the entire Earth's atmosphere and therefore global emissions (as opposed to county, state, or national emissions). As discussed in Section 4.15.3.2, climate change and climate-related environmental changes have been observed on a global level, and climate models indicate that future climate change will depend on present and future global GHG emissions. With continued increases in global GHG emission rates, climate models project that Earth's average surface temperature will continue to increase and climate-related changes will persist. Therefore, the cumulative impact of global GHG emissions from past, present, and reasonably foreseeable future actions on climate change is noticeable but not destabilizing. The NRC staff concludes that the cumulative impacts of global GHG emissions from past, present, and reasonably foreseeable future actions are MODERATE. However, as discussed above, the incremental addition of GHG emissions from the continued operation of LSCS, when compared to global emissions, are negligible and would have a net, beneficial contribution to GHG emissions and climate change impacts during the license renewal term compared to other baseload replacement power generation sources assessed in this SEIS.

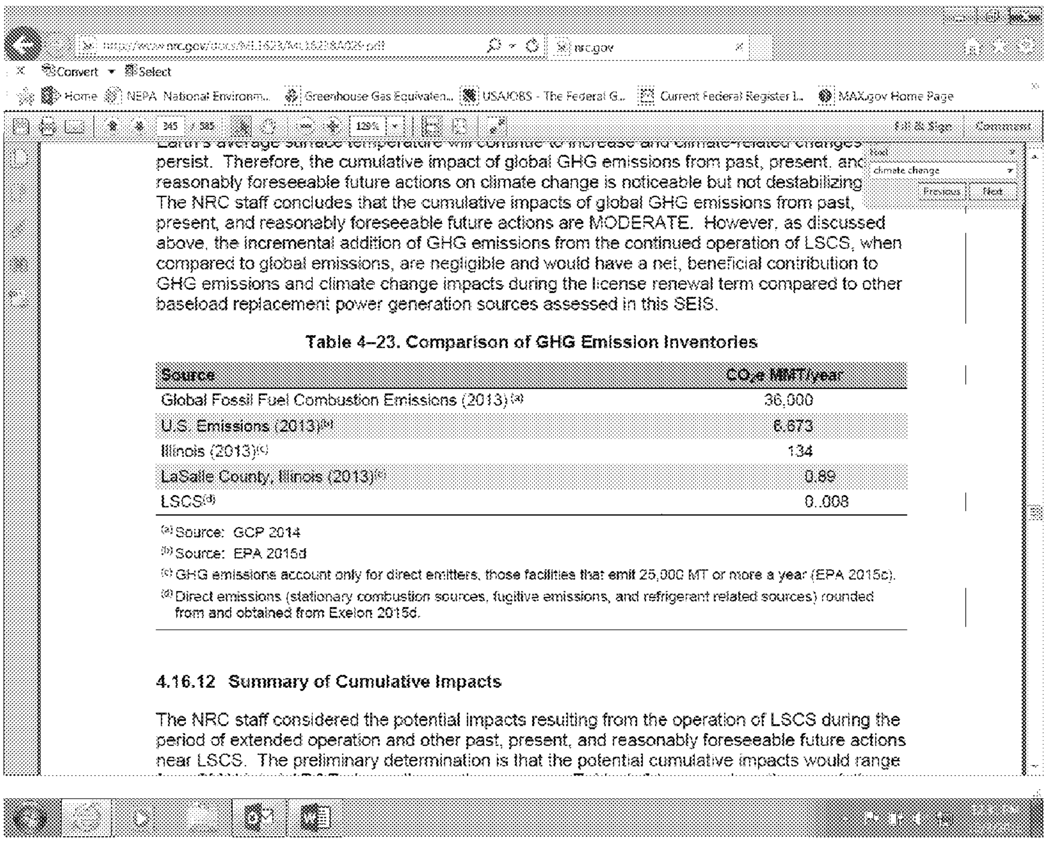


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Table 4–23. Comparison of GHG Emission Inventories

Source	CO_2e MMT/year
Global Fossil Fuel Combustion Emissions (2013)[a]	36,000
U.S. Emissions (2013)[b]	6,673
Illinois (2013)[c]	134
LaSalle County, Illinois (2013)[c]	0.89
LSCS[d]	0..008

[a] Source: GCP 2014
[b] Source: EPA 2015d
[c] GHG emissions account only for direct emitters, those facilities that emit 25,000 MT or more a year (EPA 2015c).
[d] Direct emissions (stationary combustion sources, fugitive emissions, and refrigerant related sources) rounded from and obtained from Exelon 2015d.

4.16.12 Summary of Cumulative Impacts

The NRC staff considered the potential impacts resulting from the operation of LSCS during the period of extended operation and other past, present, and reasonably foreseeable future actions near LSCS. The preliminary determination is that the potential cumulative impacts would range